

A Survey and a Co-creation Session to Evaluate Passenger Contentment on Long-haul Flight, with Suggestions for Possible Design Improvements to Future Aircraft Interiors

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Abstract To study passenger contentment data were gathered from three co-creation sessions and a survey of 128 participants with experience of long-haul flights. Negative observations related mainly to physical discomfort and feelings of boredom. While social interaction was important for some passengers, it was generally superseded by the need for privacy. Relaxation was seen as important as well by the passengers. In-flight entertainment was frequently dissatisfactory, and eating was something passengers looked forward to and viewed as a type of entertainment. Some suggestions are made as to how these findings could be integrated into future aircraft design with special attention for human factors. Our results are largely in alignment with those of previous studies.

Keywords: Passenger contentment, long-haul flight, aircraft interiors.

1 Introduction

Aircraft have been used for long-distance transportation since the early 1900s. Different types and sizes were designed and produced to accommodate the rapidly increasing number of passengers. As a fast and safe means of transportation, air travel became the preferred choice for those taking longer trips. Many redesigns focused on ergonomics and human factors have improved in-flight comfort levels over the decades, especially for long-haul flights (i.e., flights with a duration of 6-17 hours) [1]. However, much work remains to be done. While Ahmadpour et al. and Bouwens et al. have shown the need to improve seating, attention is also needed in areas including noise, smell, climate and space [2][3]. The literature outlines some of the current issues, which may be of help in defining future needs. For instance, the limited possibilities to change position and feelings of boredom were issues mentioned by Kremser et al. [4]. As early as 1975, the same authors described how people were concerned with the sense of physically restricted space. In 1999, 930 passengers evaluated different styles of seats, considering various factors including legroom, back support and head support, each of which were rated either poor or very poor by the highest percentage of surveyed passengers. A study by Li et al. confirms these findings [5]. Bouwens et al. have also shown that boredom is an issue for

passengers on long-haul flights [6]. Sleeping and the sense of being bored produce the lowest comfort scores, especially in cruise flight.

In terms of future aircraft design, it hence seems there is scope for improvement. Specifically, in terms of future design, the question arises as to what elements allow for a comfortable journey. We envision that automation will be introduced to flying within the next 30 years. AR and VR technology will be widely used in airplanes, and the cabin crew will be a combination of people and robots. Self-service for some simple tasks such as getting drinks and on-board shopping will be permitted.

The interior in question relates to the Flying V – a new type of aircraft that is being jointly developed by Airbus FPO and TUD/FPP. The airplane, which is shaped in a flying wing configuration, holds up to 315 passengers, which is comparable to a typical wide-body aircraft. The body of the Flying V is relatively flat. This includes some space that could not be used for carrying passengers due to its low height. The research question of this paper is thus: What elements of the passenger experience will influence the design of the long-haul aircraft of tomorrow?

2.Methods

Three co-creation sessions were set up to consider the elements that could potentially improve passenger experience during long-haul flights. The aim was to get an overview of the negative aspects of the current flying experience and to establish a direction for future improvements. A survey was then designed and carried out based on data from these sessions. Sanders et al. describe this method as the most useful and effective tool in the front-end design development process [7].

2.1 Co-creation sessions

The goal of these sessions was to discover the negative and positive aspects of passengers' long-haul flight experiences. Three groups were invited to participate. Each group consisted of 3-4 participants and a host (the host was always the same). In total, 10 participants aged 23-31 years participated in the study.

Printed templates showing a time line of the flight were distributed. Visuals of positive experiences using stickers, post-it notes and pens were also employed, and a line was drawn to divide positive and negative feelings.

The session proceeded as follows:

1. The host welcomes the participants and asks them to read and sign the informed consent form.
2. The host gives a brief introduction to the study.
3. The participants are asked to recall their most recent long-haul flight. They are requested to draw their experiences on the template and write down the causes of their feelings on post-its.
4. The whole group discusses their experience, mentioning elements that had a significant impact on their experience.
5. The whole group divides the post-it notes into different categories, which are colour-coded with stickers.
6. Participants point out which elements they think will still be significant in 30 years and beyond.
7. The group discusses new elements that may improve their long-haul flight experience.
8. The host wraps up and ends the session.

2.2 Online survey

A questionnaire was designed based on the results of the co-creation session and given to 128 subjects of different ages. It could be completed online using googledocs. Participants were asked to score five statements based on the negative elements summarised previously. Using a Likert scale from 1-7 (1= totally not

agree; 7 = totally agree), participants had to choose five words for their desired experience from the 14 words emerging from the co-creation session. They also had to indicate the extent to which they want to be active and engage in social interaction. In the third part of the questionnaire, two words with opposite meanings (active-inactive; social-isolated) were placed at either side of a 7-point scale. First, participants were divided into active, inactive and neutral categories. The same process was repeated for the social versus isolated. Genders and ages were also recorded for later comparison, and an open question on suggestions for improvement was added. Data were analysed as follows: averages and totals (the number of times a word is chosen) were calculated for age and gender categories. Participants were placed into two groups by age (20-40 and > 50) to see if older passengers have different preferences. T-tests were performed to compare different ages and genders, with $P < 0.05$ considered statistically significant.

3 Results

The results of co-creation sessions and the online survey were recorded separately since the online survey was designed based on the results of co-creation sessions.

3.1 Co-creation results

The topics mentioned during the sessions were divided into five categories: entertainment system, physical comfort, food, environment, and personal interaction. Figure 1 shows the number of times each category was mentioned during the session.

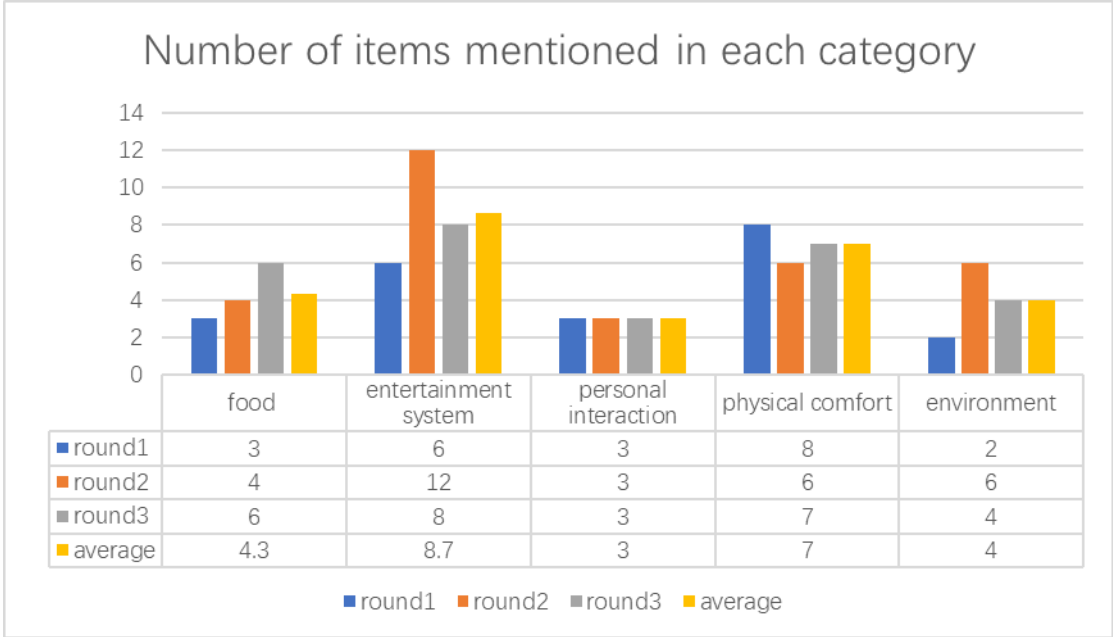


Fig. 1. Number of items mentioned in each category in the three co-creation sessions (n=10).

Entertainment was seen as very important as the flying time is quite long. Although the tablet on the chair in front enables people to watch movies and listen to music, the in-flight entertainment becomes boring after around four hours. If passengers cannot find any interesting material to watch or listen to, they get bored even faster. This situation is very likely to occur, as people have different tastes and the entertainment content cannot cater to the needs of everyone. Feeling bored also makes people more sensitive to their levels of physical comfort, especially the discomfort that is experienced due to restricted motion. In all three sessions, however, it was mentioned that passengers do not want to perform strenuous exercise or exciting activities to prevent static postures. Low-intensity movement such as walking and stretching are deemed sufficient, as the inten-

tion is not to work out but to relax and alleviate any stiffness, reducing physical distress. Sleeping in an airplane can also cause physical discomfort. A lack of neck and waist support is the main reason for the low quality of in-flight sleep. During the sessions, participants mentioned that lying down can have the added benefit of reducing motion sickness. Likewise, a positive emotional reaction occurs when people are informed that the food service will start shortly, as expectations lift and they finally have something to look forward to. Most participants (7 out of 10) said that they spend more time on eating in an airplane than they do on the ground, as they consider it a form of entertainment during a long-haul flight and hence want it to last longer. However, this does not mean they want to eat more. Conversely, passengers frequently have a low appetite. A possible reason, which was reported might be that the slower digestion and motion sickness may cause some stomach discomfort. Another reason is that many people would rather avoid going to the toilet during a flight. Airplane toilets are viewed as somewhat unhygienic, and standing in long queues for the bathroom is unpleasant. The queues are especially long after meals and before landing. People’s quality of travel is also influenced by their surrounding passengers. Most do not want to interact with others, but space is limited and physical and/or verbal contact is sometimes inevitable. Being in the vicinity of children can also be a negative factor. Around two hours before landing is the most difficult time during a long trip. Physical discomfort is at its greatest, and passengers may feel unrested and already bored with the in-flight entertainment system. They want to escape the airplane, but there is still a relatively long time before landing.

A total of 14 words expressing positive feelings were used during the co-creation sessions (pleasant, relaxed, peaceful, clear-minded, energetic, thrilled, excited, passionate, friendly, calm, joyful, adventurous, fascinated, powerful). Those with the highest frequency were: relaxed, peaceful and interesting. The words pleasant, friendly and calm were also mentioned more than once.

3.2 Online survey results

Figure 2 shows the averages for each age group. The graph indicates that older people are calmer and more tolerant (their answers are more neutral) than the younger group. The difference for the food service is very slight, while the biggest difference is in attitudes to children. Young people care more about this issue than seniors. This may be explained by the fact that seniors have experience of raising children, and are thus more tolerant of their behaviour. Table 1 shows the T-test results for the different age and gender groups. Statistical significance was found for all the statements except for the one about attitudes to food service. However, there were no significant differences regarding gender.

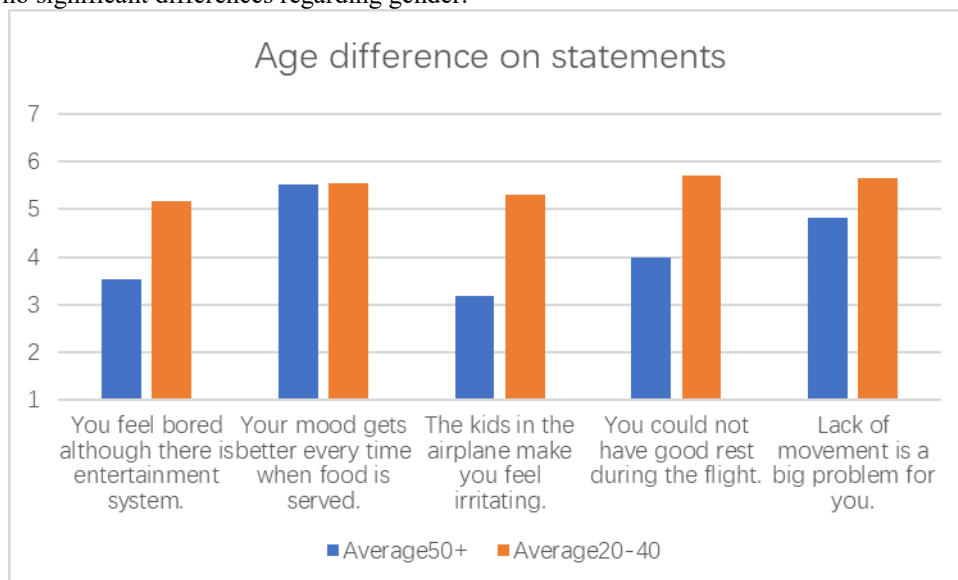


Fig. 2. Average score on the 5 statements for the different age categories (20-40, n=106; > 50, n=21).

Table 1. T-Test results on the five statements.

Statements	<i>P</i> (different ages)	<i>T</i> (different ages)	Standard error of deference (different ages)	<i>P</i> (different genders)	<i>T</i> (different genders)	Standard error of deference (different genders)
You feel bored even though there is an entertainment system.	<0.0001	4.7737	0.343	0.3481	0.9419	0.281
Your mood improves when food is served.	0.9368	0.0794	0.294	0.0665	1.8511	0.214
The kids in the airplane make you feel irritated.	<0.0001	6.0645	0.348	0.0629	1.8765	0.289
You could not get a good rest during the flight.	<0.0001	5.4121	0.315	0.9632	0.0463	0.259
Lack of movement is a big problem for you.	0.0114	2.5674	0.328	0.8018	0.2516	0.249

For the second part of the questionnaire, participants had to choose from the list of 14 words to describe a desirable experience. A tally was made of the number of times each word was chosen (see figure 3). Quality, relaxed, peaceful and pleasant were the most frequently chosen words, which aligned with results from the co-creation sessions. This indicates that on-board activities do not need to be intensive or thrilling. More people aged 20-40 chose the word *energetic* compared to people over 50, while the inverse was true for the word *calm*. However, this difference is not typical. No significant gender differences were found in this area.

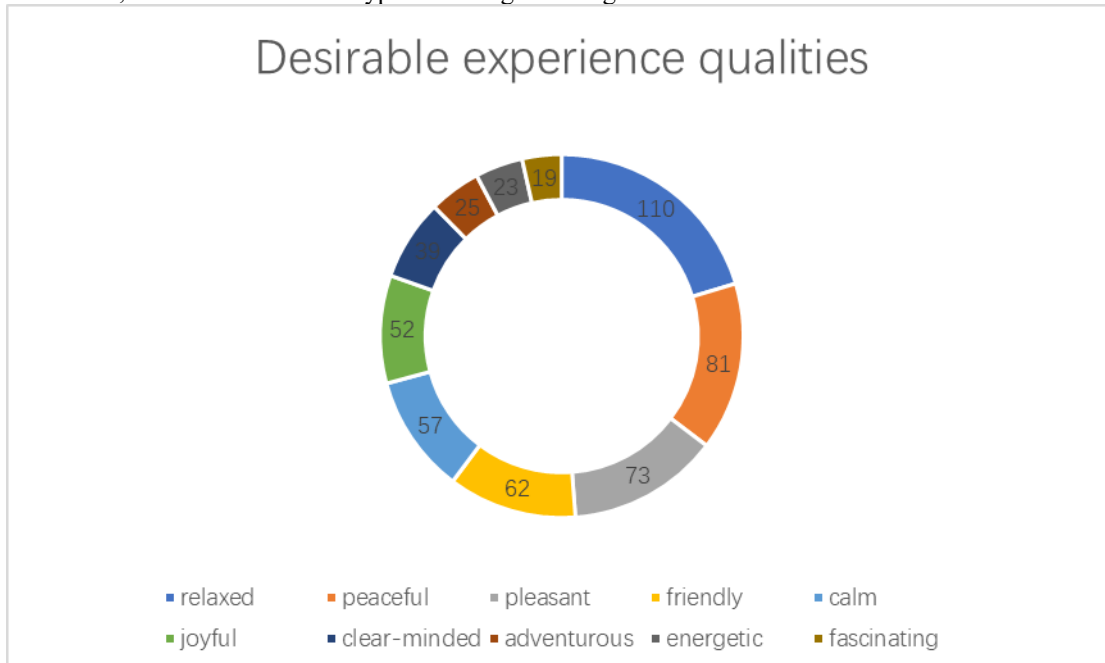


Fig. 3. The number of times each word was chosen for the preferred activity (n=128).

Active-inactive and social-isolated results are shown in figure 4. These indicate that most people want to be both inactive and isolated in the aircraft. However, about one-sixth of respondents anticipated that their future airplane experiences would be more active and socially involved. A significant difference was found between the genders regarding levels of activity. Figure 5 shows that people age 20-40 were more active than people over 50. The level of preferred social interaction depended largely on gender, with males preferring less social engagement (see Figure 6).

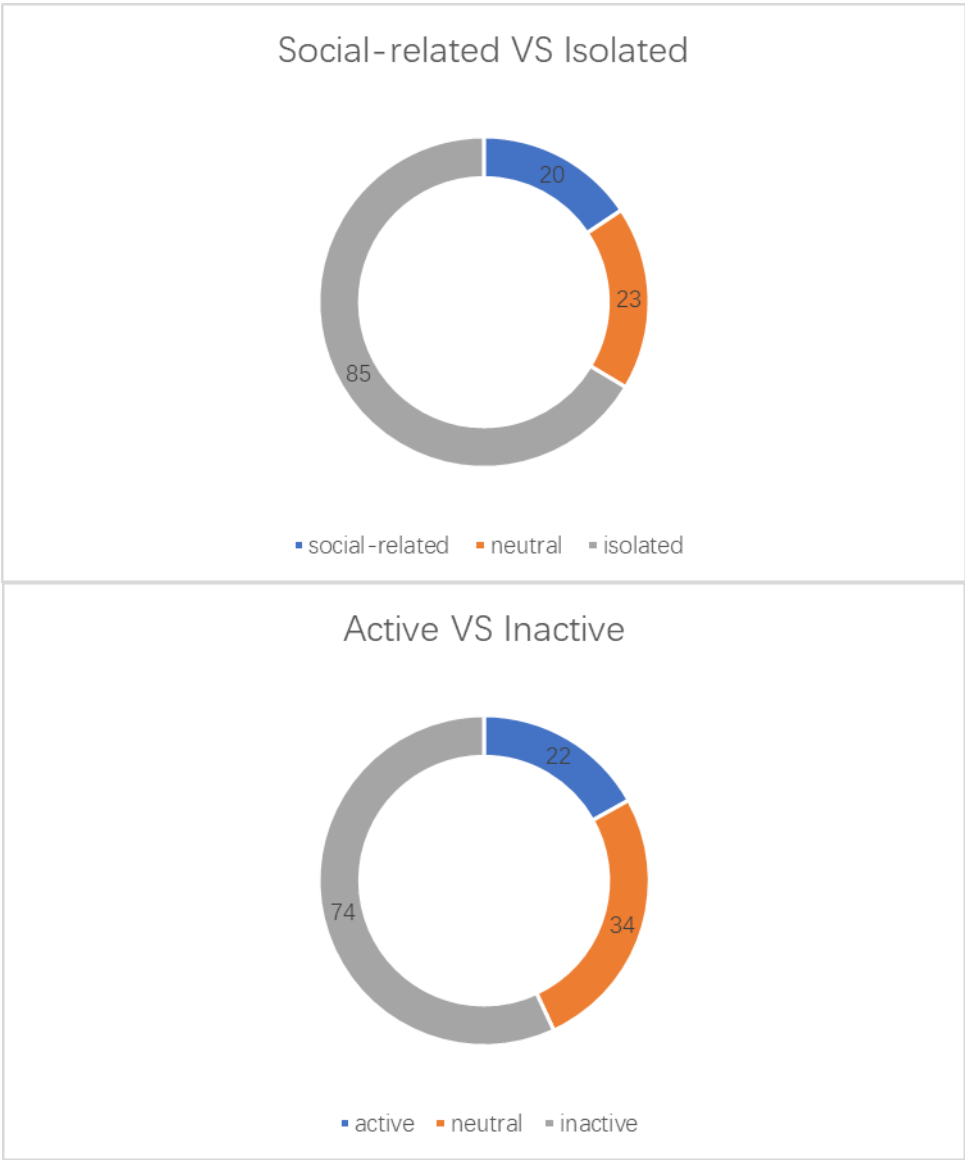


Fig. 4. Number of participants for active vs inactive and social vs isolated (n=128).

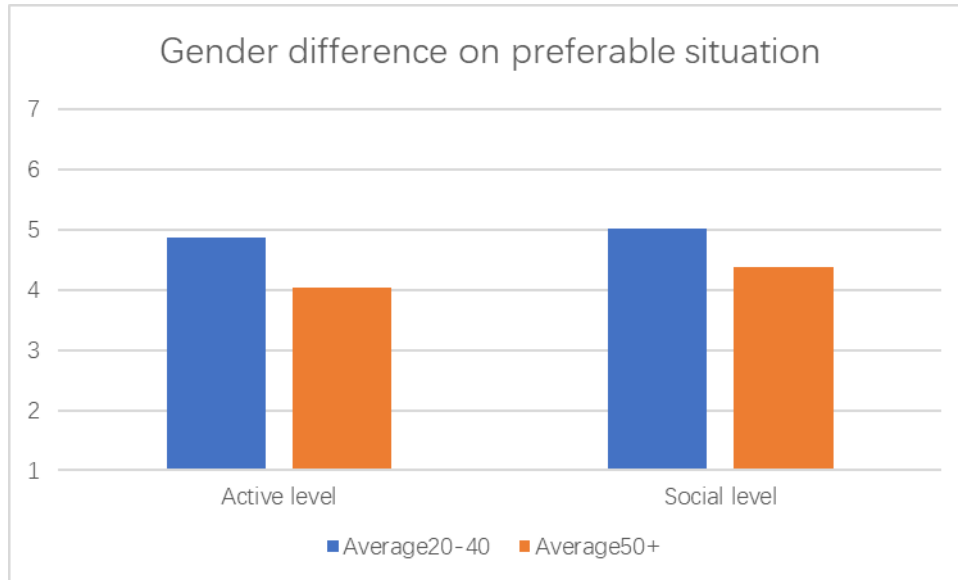


Fig. 5. Different preferences by age (20-40, n=106; 50+, n=21).

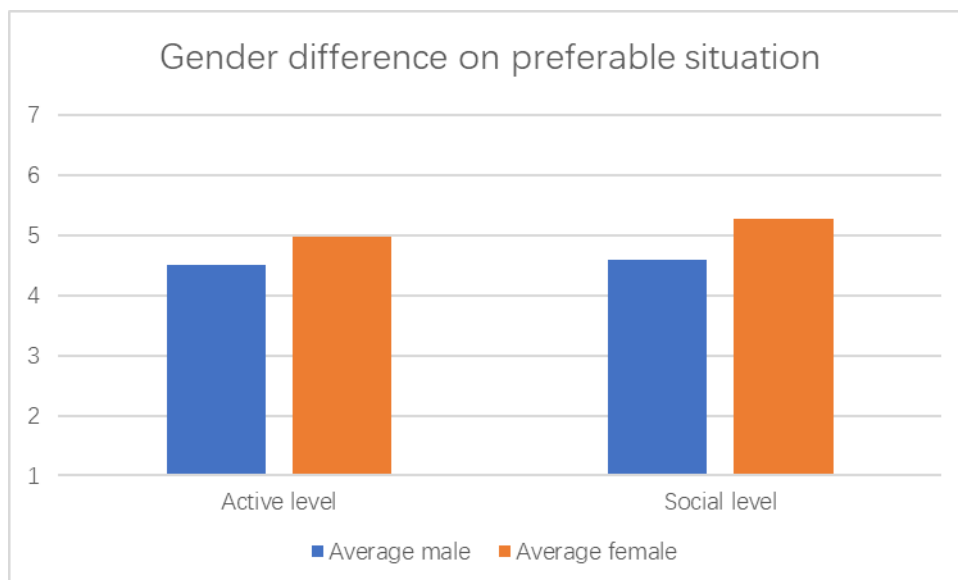


Fig.6. Different preferences by gender (male, n=68; female, n=60).

Table 2. T-Test results on preferable situation.

<i>Preference</i>	<i>P (different ages)</i>	<i>T (different ages)</i>	<i>Standard error of deference (different ages)</i>	<i>P (different genders)</i>	<i>T (different genders)</i>	<i>Standard error of deference (different genders)</i>
Being active.	0.0140	2.4936	0.329	0.0511	1.9691	0.245
Being social.	0.0556	1.9318	0.330	0.0044	2.9005	0.240

4 Discussion

Both the co-creation session and the questionnaire revealed that passengers prefer relaxed activities during the flight as a means to reduce physical discomfort and feelings of boredom. This finding is in agreement with those of other studies. Gregghi et al. state that the activity passengers find most difficult is resting/sleeping (76.7% of the 287 participants). In this study, 50% of passengers also experienced difficulties in using the in-flight entertainment [8]. Bouwens et al. showed that the lowest comfort rates were associated with sleeping and feelings of boredom [6]. Our results are also largely in agreement with those of a study by Hiemstra-van Mastrigt et al., which reports that discomfort was significantly lower while passengers were eating, with respondents from their online survey indicating they felt most refreshed after food (34.8%) [9]. Likewise, walking through the plane was also perceived as the most refreshing activity by a majority of long-haul passengers (>6 h) - a result that is in line with our findings - with limited opportunity for physical movement being a cause of discomfort. Our results indicated that the majority of passengers do not desire social interaction and there is no necessity to make the plane into a social space. This is confirmed by Buchholz & Chinlund, who state that solitude is a basic-level human need [10]. In this paper, we mention that eating can help make the passenger experience more interesting. Pine et al. mention that in-flight food could function as a form of entertainment, as is the case in certain theme parks [11]. Meiselman also suggests that experiencing the same food in a different setting offers a different experience, although how this could be integrated into airline dining remains uncertain [12]. Long queues for the toilet can be unpleasant - a finding confirmed by Rarnakar - and certain aircraft have already made changes to the toilet layout to reduce waiting times [13]. However, these redesigns are not yet widely introduced, and there may yet be more effective solutions to this problem. All of these points require further examination.

This study contains certain limitations. In the survey, the age range 40-50 is missing. Genders were also not equally distributed for all ages. Likewise, the co-creation sessions featured a limited age group. These may be the cause of some inaccuracy in the results, especially in the case of the missing age group, as there are clearly some differences to be observed between the different generations. In our study population the young might be overrepresented. However, young people will be the passengers of tomorrow, increasing the relevance of their responses in terms of future aircraft design.

5 Design take-aways

Based on the above results, the following are some suggestions for designers that may help to create a better passenger experience during long-haul flights:

1. More space for passengers to move around.
2. In-flight activities should focus on making people feel relaxed rather than excited. An interior should make it possible to have privacy; however, there should also be some space for passengers who enjoy social interaction. The ideal combination would involve higher levels of privacy.
3. Food service is seen as a relief from boredom. Extending eating times may help to improve the overall experience.
4. Children disturb other passengers. Adding a separate family area could be a solution that may also be appealing for families. Parents could interact with each other while their children play, allowing other child-free passengers to enjoy a more peaceful trip.
5. Toilets are currently used both for bodily functions and as a place for washing hands/faces and changing clothes. Some women also use the mirrors in the toilet to do their makeup. If a separate space could be found for these alternate uses, the waiting line might be shorter.

6 Conclusion

This paper studied the negative and positive experiences of passengers on long-haul flights. Results suggest that physical discomfort and feelings of boredom during the flight are the main causes for concern. Ideally, the future aircraft should be designed in such a way as to contribute to a relaxed, peaceful and pleasant ex-

perience. This would require the significant re-design of existing aircraft interiors. While social interaction and privacy should be both possible during a flight, the majority of passengers prefer privacy. Activities such as eating and going to the toilet have a significant impact on the overall experience, and should be taken into consideration in the design process.

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